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## (54) IMPROVEMENTS IN OR RELATING TO PROTECTIVE HEAD GEAR

(71) I, SECRETARY OF STATE FOR DEFENCE, London do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with protective head gear and with the provision of protective head gear capable of providing a snug and comfortable fit upon the head of a wearer.

In accordance with the present invention an article of protective head gear includes an internally padded shell in which the padding is formed of substantially incompressible spheroids constrained by a gas permeable fabric attached to the inner surface of the shell by means of tie members or membranes such that when the said head gear is worn the spheroids form a cushioning layer of approximately constant thickness between the head of the wearer and the inner surface of the shell and wherein the spheroids are of a suitable size and have a sufficiently low coefficient of friction that when the head gear is placed upon the head of the wearer they can be displaced relative to one another to conform substantially to the shape of the head of the wearer.

Preferably the spheroids are constrained by an appropriately shaped bag one side of which is bonded to the inner surface of the shell and at least the opposing side of the bag is of gas permeable fabric and tie members are attached between the side of the bag bonded to the inner surface of the shell and the opposing side of the bag, the said opposing side making contact with the head of the wearer when in use.

In accordance with an alternative aspect of the present invention an article of protective head gear includes a shell having on its inner surface a number of cushioning pads each pad formed of substantially incompressible spheroids constrained by gas permeable fabric attached to the inner surface of the shell by means of tie members or membranes, the size and spacing of the pads being such that when the said head gear is

worn the pads act to separate the head of the wearer from the inner surface of the shell by an approximately constant distance and wherein the spheroids are of a suitable size and have a sufficiently low coefficient of friction that when the head gear is placed on the head of the wearer they can be displaced relative to one another to conform to the shape of the wearer's head where the head makes contact with the pads.

Preferably each pad is formed from an appropriately shaped bag enclosing the spheroids, one side of each bag is bonded to the inner surface of the shell and at least the opposing side is of gas permeable fabric, and tie members are attached between the side of the bag bonded to the inner surface of the shell and the opposing side of the bag, said opposing side making contact with the head of the wearer when in use. The tie members serve to maintain the bag in shape.

Preferably the tie members are about 1" long and are spaced at about 1" distance from each other.

Although at least a portion of each bag is of a flexible gas permeable fabric, other parts of each bag may constitute tie membranes by which the gas permeable fabric is attached to the shell.

Preferably the spheroids occupy between 80 and 90% by volume of the space available.

If the padding on the interior surface of the shell is in the form of a plurality of individual bags it is preferable that the bags form cylindrical pads of about 4 inches diameter and about 1 inch in length.

The pattern of filled individual bags may be determined by trial, taking into account comfort of the wearer and tests to determine the effectiveness of protection from a violent blow afforded by the head gear and the requirements of ventilation.

In the present specification substantially incompressible is used to mean incompressible under the forces exerted upon the spheroids when the head gear is being worn normally but not necessarily incompressible under violent impact.

In accordance with an aspect of the present invention the spheroids are selected to be substantially incompressible in normal use but to crush irreversibly and with absorption of energy when subjected to a violent impact by a body having a greater than a predetermined momentum.

The spheroids should be small enough to present a substantially smooth surface contour to the head of the wearer whilst also being sufficiently large to permit free circulation of air through the interstices between adjacent spheroids. The embodiment including separate pads has the advantage of providing increased ventilation of the head of the wearer.

Protective head gear manufactured in accordance with the present invention has the advantage that the area of contact between the head of the wearer and the headgear is of gas, and also liquid, permeable material permitting relatively free ventilation of the contact area on the head of the wearer and thereby reducing the discomfort due to sweat which arises in helmets in which the area of contact is non-permeable. Advantageously the head gear may be provided with forced ventilation by means of a suitable small pipe or pipes introducing air into the said pads or into the spaces between the said individual pads, thereby increasing the ventilation of the contact area.

In certain instances the wearers of protective head gear are required to use telecommunications equipment, for example, aircraft crews and tank crews. In such circumstances it is frequently necessary to provide a snug fit around the ear of the wearer for the earphones so that noise from the environment may be excluded as far as possible and it may be convenient for protective head gear of the present invention to include at least one ear cup with a space capable of receiving the ear of the wearer and surrounded by an annular pad of flexible gas permeable material enclosing substantially incompressible spheroids as hereinbefore set forth. As a general rule the head gear will be provided with two ear cups, which may be movably mounted.

The telecommunications equipment may be integral with the head gear or may constitute a pair of earphones which are worn under the head gear.

The present invention will now be described with reference to the accompanying drawings in which:

Figure 1 is a perspective view of one embodiment in partial cross-section, and

Figure 2 is a perspective view of another embodiment also in partial cross-section.

In Figure 1 the protective head gear has a shell 1 and is cut away to show a space 2 between the inner surface 3 of the shell 1 of the head gear and the outer surface of

a fabric whose inner surface 4 contacts the head of a wearer of the head gear when in use. The fabric is of flexible gas permeable material. The space 2 is provided with tie members 5 to attach the fabric to the shell, thereby to maintain the contacting surface 4 in position, and is filled to the extent of 80 to 90% by volume of the available space with expanded polystyrene spheroids 6 each having a mean diameter of 3 mm and density about 4 lb per cubic foot, which form a cushioning layer of approximately constant thickness. It will be realised that only some of the spheroids are illustrated for convenience. The spheroids are sufficiently small and smooth to be displaced relative to one another in use to conform substantially to the shape of a wearer's head.

The head gear is also provided with a right ear cup 7 and a left ear cup 8, which is shown in section to illustrate a pocket 9 surrounded by an annular pad 10 also filled with expanded polystyrene spheroids into which pocket the ear of the wearer fits in use.

Figure 2 shows an article of a head gear similar to that illustrated in Figure 1 but with the left ear cup removed for clarity, and has a shell 1 with an inner surface 3 to which is attached a number of individual bags 12 each containing expanded polystyrene spheroids 6 to the extent of 80 to 90% by volume of the space available within each compartment 12. The surfaces of the individual bags 12 remote from the shell of the head gear taken together constitute the gas permeable contacting surface 4 between the head gear and the head of the wearer and the walls 13 of the bags 12 constitute tie membranes by which the contacting surface 4 is connected to the inner surface of the shell 1. Figure 2 illustrates one possible pattern of siting of such individual bags, but other patterns are possible, being determined by wearer comfort and efficiency of shock absorption. In use the bags provide an approximately constant spacing between the shell and a wearer's head. The head gear also includes an ear cup 7 with an annular pad 10 defining a pocket 9 into which the ear of the wearer fits.

Expanded polystyrene spheroids having a density in the range of 2 to 10 lb per cubic foot may be used in either embodiment.

It will be realised that the head gear illustrated in the drawings may be modified whilst still remaining within the scope of the present invention. For example the ear cups may be omitted for motor cycle crash helmets or the like, or the ear cups may be movably mounted in order to accommodate individual ear positions.

#### WHAT I CLAIM IS:—

1. Protective head gear including an in-

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ternally padded shell in which the padding is formed of substantially incompressible spheroids constrained by a gas permeable fabric attached to the inner surface of the shell by means of tie members or membranes such that when the said head gear is worn the spheroids form a cushioning layer of approximately constant thickness between the head of the wearer and the inner surface of the shell and wherein the spheroids are of a suitable size and have a sufficiently low coefficient of friction that the head gear is placed upon the head of the wearer they can be displaced relative to one another to conform substantially to the shape of the head of the wearer.

2. Protective head gear including a shell having on its inner surface a number of cushioning pads formed of substantially incompressible spheroids constrained by gas permeable fabric attached to the inner surface of the shell by means of tie members or membranes, the size and spacing of the pads being such that when the said head gear is worn the pads act to separate the head of the wearer from the inner surface of the shell by an approximately constant distance and wherein the spheroids are of a suitable size and have a sufficiently low coefficient of friction that when the head gear is placed on the head of the wearer they can be displaced relative to another to conform to the shape of the wearer's head where the head makes contact with the pads.

3. Protective head gear as claimed in claim 1 wherein the spheroids are constrained by an appropriately shaped bag one side of which is bonded to the inner surface of the shell and at least the opposing side of the bag is of gas permeable fabric, and tie members are attached between the side of the bag bonded to the inner surface of the shell

and the opposing side of the bag, the said opposing side making contact with the head of the wearer when in use.

4. Protective head gear as claimed in claim 2 in which each pad is formed from an appropriately shaped bag enclosing the spheroids, one side of each bag is bonded to the inner surface of the shell and at least the opposing side is of gas permeable fabric, and tie members are attached between the side of the bag bonded to the inner surface of the shell and the opposing side of the bag, the said opposing side making contact with the head of the wearer when in use.

5. Protective head gear as claimed in claim 2 or claim 3 wherein the tie members are about 1" long and are spaced about 1" distance from one another.

6. Protective head gear as claimed in claims 2, 3 or 4 wherein the bag or bags are entirely of gas permeable material.

7. Protective head gear as claimed in any preceding claim wherein the spheroids occupy between 80 and 90% by volume of the space available between the constraining fabric and the shell.

8. Protective head gear as claimed in any preceding claim wherein the spheroids are selected to be substantially incompressible in normal use but to crush irreversibly and with the absorption of energy when subjected to a violent impact by a body of greater than a predetermined momentum.

9. Protective head gear substantially as hereinbefore described with particular reference to either Figure 1 or Figure 2 of the accompanying drawings.

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